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Cloud Computing and Higher Education Financial Crisis

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ABSTRACT

With the Financial crisis and being challenged by growing needs, universities face problems providing necessary information technology (IT) support for educational, research, and development activities. This paper aims to find alternatives to the use of IT while leading universities to improve awareness and funds. The model matured and consisted of a rigorous analysis of the latest research on Cloud Computing as an alternative to IT provision, management, and protection. The results are encouraging and supportive use of Cloud solutions in universities by improving knowledge and providing a practical guide adjustable to the university structure. The proposed model considers the university architecture and criteria such as goal, availability, and importance of applications and the data's mission, understanding, privacy, reliability, and accessibility.

KEYWORDS: *Cloud Computing, Higher Education, Financial Crisis, Cloud Strategy, Cloud Architecture*

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INTRODUCTION

The worldwide integration and globalization of finance are among the significant developments of this age. The process and its effects have been intensified through various factors, including economic and trade reform (Harvey, 2014). With the emergence of neoliberal impulses, we have been experiencing an increasing interest in the education of the workforce and the mobilization of financial resources to accomplish this task (Harvey, 2014). The economic downturn of 2008-2009 will exaggerate the fundamental problems facing American Higher education and make them more challenging to address, let alone reverse or attenuate (Geiger, R., 2010). The downward ratchet in attendance decisions will make the selective sector more socially exclusive (Geiger, R., 2010).

American higher education reflects the nation's ideals, with higher education serving as the dynamo of the dream of upward mobility. However, a fair interpretation of the recent past signals a loss of confidence in civic culture (Frank H., 2017). Moreover, the student's identity and enthusiasm for the schools are related. Increasing demographic diversity has correlated to decreasing financial support at the state schools that enroll the preponderance of students (Frank H., 2017). The dual narratives of access to schools for diverse populations and divestment of assets by government officials explain the current mess. The goal and struggle for students are to improve their lot in life; for their schools, to balance the budget (Frank H., 2017). The proportion of the population who have completed a four-year degree has continued to grow. A third of people aged 25 and over hold a baccalaureate. The mid-1970s constitutes a doubling of the percentages among whites and a tripling of black (Census Bureau report, 2016). The overall rate of women who possess a bachelor's degree has now reached parity with men (Census Bureau report, 2016).

Higher education institutions are during historic times in the United States and globally. In the United States, the deep recession and depleted budget reserves have contributed to a diminishing tax base resulting in drastic budget cuts to state-funded state-assisted universities and colleges (Lewin, 2010). The endowments at private and public higher education

institutions in the United States are typically relied on as a source of relief during a financially troubling time and have experienced losses not seen since Great Depression (Lewin, 2010). Higher education was acknowledged as one of the pillars of society's development. Through the partnerships between universities, government, and industry, researchers and students have proven their contribution to the transformation of society and the entire world economy (Lazowska et al., 2008). With the evolution of technology, the number of services that migrate (Mircea, 2010; Bozzelli, 2009) from the traditional form to the online form grows (Ivan et al., 2009). For the specific services, an adequate providing form must be found in the online environment, using the appropriate technologies, guaranteeing the access of many users, and providing rapid and reliable payment services (Ivan et al., 2009).

The deficit and in the climate of unprecedented budget cuts, institutions of higher education are invoking mass layoffs, sleep tuition hikes, department closures, mandatory absences, and early retirements; even the threat of closures of university and college systems looms, as demonstrated by an event in July 2011 that threatened to shutter the entire Minnesota State Colleges and Universities system (Budig, 2011). In 2011, it was reported that 43 states in the U.S. had imposed funding cuts to higher education in the coming budget cycle (Johnson et al., 2011). Therefore, the 2011 fiscal budgets for U.S. universities and colleges appear much worse than the previous biennial, and there is no promise of reprieve in the foreseeable future.

Higher education institutions have resorted to various cost-cutting measures to address their financial shortfall during the economic downtown, including significant cuts to information technology budgets. For example, for the 2009-2010 academic year, 50% of IT leaders at universities and colleges in the U.S. reported decreased funding in their IT budgets over the previous year (Green, 2009). The purchasing power of IT dollars has decreased; IT costs have increased faster than the rate of inflation (Golden, 2009).

The moment universities are confronted with a dramatic increase in costs in higher education, more than the inflation rate (Golden, 2010), and a decrease in universities budgets, which leads to the pressure of finding some alternative means of reaching their purpose. The education of students and accomplishing the research. The university handles these pressures with changing performance to be service-oriented and optimize the efficiency and effectiveness of all internal operations and interactions with the main stakeholders (Mircea and Andreescu, 2010). At the organization level, Cloud Computing may be considered an extension of SOA (Service Oriented Architecture) (Mircea et al., 2011) and an alternative to the use of IT for the educational environment, especially in the conditions of the present financial crisis. From his point of view, it is essential to identify data, services and processes suitable candidates to reside in the cloud. Without SOA, migrating toward the cloud has no sense from a financial point of view (Mircea et al., 2011).

Define Cloud Computing

Cloud computing is a subscription-based service where you can obtain networked storage space and computer resources (Lewis, 2009). In early 2009, McKinsey & Company reported 22 district definitions of cloud computing. In the last two years, the surge of interest in cloud computing has increased this list. In addition, one of the challenges is the evolving and expanding nature of the cloud computing concept, which will propagate new definitions over time and make it difficult to pinpoint a single purpose (Lewis, 2009). McKinsey & Company (2009) define cloud computing as hardware-based services offering computing, network, and storage capacity where hardware management is highly abstracted from the buyers, buyers incur variable infrastructure costs, and infrastructure capacity is highly elastic.

Using Cloud Computing in Higher Education

Many universities have recognized the Potential and efficiency of using Cloud Computing in higher education, including the University of California, Washing State University's school of electrical Engineering and Computer Science, higher education institutions from the UK, Africa (Sultan, 2010), U.S and others. Cloud Computing offers universities the possibility of concentrating more on teaching and research activities than complex IT configuration and software systems (McCREA, 2009) through a fast IT implementation. The complexity can be reduced with Cloud Computing (Tout et al., 2009).

Cloud solutions can support cooperative learning and socially oriented theories of learning, using computer technologies to help collaborative methods of instruction (Thorsteinsson et al., 2010). Cloud Computing offers many benefits to e-learning solutions by providing the infrastructure, platform, and education services directly through cloud providers and using virtualization, centralized data storage, and facilities for data access monitoring (Pocatilu et al., 2009). There are many practices and examples regarding the use of cloud computing. For instance, in the commonwealth, many colleges and universities collaborated on forming the Virginia

Virtual Computing Lab (Wyld, 2009). It allowed institutions to cut IT expenses, maintain their data centers, and improve IT resources for research and students. Cloud services, including in North Carolina State University, achieved a substantial decrease in expenses with software licensing and, at the same time, reduced the campus IT staff from 15 to 3 employees with a complete working schedule (Wyld, 2009).

Table 1: Benefits and Limitations of Using Cloud Computing in Higher Education

Benefits	Limitations
Access to applications from anywhere	Not all applications run in the cloud.
Supports for teaching and learning	Risks related to data protection and security And accounts management.
Software free or pay per use	Organizational support
24 hours access to infrastructure and content	Dissemination politics, intellectual property.
Opening to the business environment and advanced research	Security and protection of sensitive data
Protection of the environment by using green Technologies	Maturity of solutions
Increasing functional capabilities	Speed/lack of internet can affect work methods.

The decision-taking of using Cloud Computing must consider the risks of non-implementing and the implementation risk associated with the solution (Patterson, 2010). Implementing the solution must obtain a gain exceeding capital cost and compensate for the associated risks. Many of the risks specific to cloud the IT leaders from higher education have considered that improving IT services is the most critical decision factor, while only 38% emphasized cost reduction (Patterson, 2010).

Risk assessment becomes a critical task, and risks related to cloud computing are transferred to the cloud service provider (Patterson, 2010). Several organizations have emerged in the last few years to help diminish these risks for higher education institutions. The Cloud Security Alliance was launched in 2009 as a non-profit organization tasked with conducting research in cloud security and offering information and resources about best practices in security protection in cloud computing (EDUCAUSE, 2010). The higher education information security council, a subgroup of EDUCAUSE, provides membership and comprehensive resources and engages members in a dialogue on issues, challenges, and solutions in the area. (EDUCAUSE, 2010).

Cloud Service Models for Higher Education

Cloud computing is delivered via different service model architectures. The most common models for education are SaaS, PaaS, and IaaS. The following summarizes definitions and gives examples of each model (Matsumoto, 2012).

1. Software as a Service (SaaS)- applications are deployed over a network (web) and are accessible via browser or program interface. Since applications are offered through the software on demand, they can be deployed quickly, bringing ease of use and financial benefits. Examples of companies providing this platform are Google Apps (email, calendar, and documents), Salesforce.com, and Intuit-QuickBooks.
2. Platform as a Service (PaaS) provides an agile development environment that makes it easier for the user to develop applications quickly and adapt them instantly. The wait for deploying suitable hardware and software for application is eliminated. Users can use the platform to build applications using language, libraries, services, or tools supported by the provider Examples of companies providing this type of platform are Google App Engine, Windows Azure, and Force.com
3. Infrastructure as a Service (Iaas)- This platform provides general-purpose support services, including infrastructure services such as database, storage capacity, networking, and other computing resources. The user controls operating systems and deployed applications, and Examples are Mazon Web services, Century Link, and Rackspace.

Cloud Architecture for University

Thinking, planning, and working in the cloud requires universities to cope with specific challenges of the cloud environment (Bristow et al., 2010), such as uncertain definitions, privacy, contractual and jurisdictional issues, risk and nonperformance, interoperability, network capacity, rearchitecting, staff, and perceptions. Also, the adoption of cloud

architecture involves overcoming barriers, such as policy and control issues, new services that will move above campus before older self-operated services, using an "accidental strategy" formed around consumer choice (Katz et al., 2009), organizational culture and regulatory considerations (Katz et al., 2010). The successful use of cloud computing in higher education presupposes the existence of three key elements: virtualization, the intelligence from the network, and a robust ecosystem (Bozzelli, 2009). These offer the basis for obtaining operational efficiency, security, activity continuance, scalability, and interoperability, leading to innovation. In addition, government involvement in organizing a centralized cloud at the higher education level may stabilize the academic field (Sasikala & Prema, 2010) and lead to fast results in research and innovation.

The success of the strategy implementation depends on a service-oriented architecture at the institution level that offers the necessary infrastructure for cloud implementation (Sheelvant, 2009). Migrating toward the cloud has no sense from the financial point of view because it leads to high costs with reengineering existing systems (Kavis, 2009). Also, the cloud strategy must be aligned with the university strategy to succeed. To start from the researchers related to the transition to cloud computing and the experiences of universities in a sing it, it suggested a migrating strategy words cloud, formed of the following stages,

Stage 1: Developing the knowledge base about Cloud Computing: The stages consist of developing the knowledge by participating in conferences and discussing with the consultant to support the institutes in successfully allocating budgets for the research. And to understand the needs of the research faculty, staff, students, administrative department and exam department, and the network department within the institute. To understand the organization's SWOT analysis.

Stage 2: Evaluating the present university stage: The second phase consists of the categories interacting with the existing system and its requirements. In this stage, the structure and the services that must be kept with the institute are decided. Also, to understand the benchmark for security and legal compliance issues by comparing the internal practices of the organizations.

Stage 3: Experimenting with the Cloud Computing solutions: This stage started testing a pilot project in the cloud and then externalizing the applications chosen for the cloud. The settings are set up with the cloud's development and environmental testing data. The step consists of daily processing of the internal operations, addressing at the same time the components of public and private cloud to assure the security and protection policies (Bozzelli,2009).

State 4: Choosing the Cloud Computing solution: The steps involve identifying data and applications, functions, and central processes within the university. This research stage may be grouped according to the three large categories of university activities: teaching, research, and administrative support.

Stage 5: *Implementation and management of the Cloud Computing solution:* The solution implementation may be done in iterative phases, through a continuous transition of the data, services, and processes towards the cloud, with the eventual return from cloud to operations, internally hosted. It is performed based on continuous evaluations of the cloud technology benefits to the university. The implementation supposes establishing a flexible program of risk management testing the solution performance and implementation management (ISACA, 2009).

On the other hand, data migration must be performed by keeping an optimum balance between the data accuracy, migration speed, nonfunctioning time, and minimum costs. The educational organization must need their cloud computing solutions regarding security, management of the application and infrastructure, control of the risks, and continuous evaluation of the Cloud Computing solution (Mircea et al., 2011). It supports proactive quality assurance by measuring and improving processes, procedures, and services.

Conclusion

Cloud Computing is an emerging technology paradigm that promises to provide a solution to the current financial crisis faced by Higher Education institutes. The world is changing daily with the form from traditional to modern in every sector. Regarding the critics and drawbacks, it seems that Cloud Computing is here to stay, and the present economic situation will force more and more organizations to adopt the solution with decreasing expenses due to implementing cloud solutions. The migration from the traditional system towards Cloud Computing would enable Higher Institutions to manage rapidly changing software and hardware at a lower cost may help the higher education institutions. The higher education institutions expect to cut 20% of their IT funding by shifting most of its application to the cloud. The major shift in approach provides a significant opportunity to increase organizational effectiveness, improve skills, and stimulate creativity. Executing cloud solutions in higher education will require specific requirements to be fulfilled. In most colleges and universities, there is a gap between the

strategic vision and understanding of available technologies and the budget available to deliver on that vision to understand the financial crisis and the university's attitude towards the future.

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